UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/589,886	08/18/2006	Ryouichi Takeuchi	Q80551	3539

23373 7590 12/16/2008

SUGHRUE MION, PLLC
2100 PENNSYLVANIA AVENUE, N.W.
SUITE 800
WASHINGTON, DC 20037

EXAMINER	
BELOUSOV, ALEXANDER	
ART UNIT	PAPER NUMBER
2894	

MAIL DATE	DELIVERY MODE
12/16/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/589,886	TAKEUCHI ET AL.	
	Examiner	Art Unit	
	ALEXANDER BELOUSOV	2894	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 September 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5, 7 & 9-13* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7 and 9-12* is/are rejected.

7)☒ Claim(s) *13* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action is in response to the amendment filed on 09/19/2008. Currently, claims 1-5, 7 & 9-13 have been examined.

Claim Rejections - 35 USC § 103

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. **Claim(s) 1-4, 10 & 12** are rejected under 35 U.S.C. 102(b) as anticipated by (US-2003/0234400) by Udagawa or, in the alternative, under 35 U.S.C. 103(a) as obvious over (US-2003/0234400) by Udagawa in view of (US-2003/0027099) by Udagawa ("Udagawa2").

Regarding claim 1, Udagawa discloses in FIG. 6 and related text, **e.g.**, a compound semiconductor light-emitting diode comprising a light-emitting layer (604) composed of a Group III-V compound semiconductor, and a current diffusion layer (607) provided on the light-emitting layer and composed of a Group III-V compound semiconductor, characterized in that the current diffusion layer is composed of a conductive boron-phosphide-based semiconductor (paragraph 128) and has a bandgap ("***about*** 3.1 eV") at room temperature wider than that of the light-emitting layer (2.9 eV),

wherein the diode includes, in a thickness direction between the current diffusion layer and the light-emitting laver, a cladding layer (605) composed of a Group III-V compound semiconductor, and the cladding layer has a bandgap at room temperature ("***about*** 3.1 eV") wider than that of the light-emitting layer and equal to or narrower than that of the current diffusion laver, and

wherein both the cladding layer and the current diffusion are composed of a boron-phosphide-based semiconductor having a boron compositional gradient (see paragraphs 127 & 128; 605 is n-type boron phosphide and has carrier concentration of 2x10^18 cm-3; 607 is Si-doped n-type boron phosphide and has carrier concentration of 8x10^18 cm-3; hence, "having a compositional gradient") such that the bandgap increases in the thickness direction from the bottom surface of the cladding laver closest to the light-emitting layer to the top of the current diffusion layer (as has been pointed out above, the bandgap of each of the "current diffusion layer" and the "cladding layer" is ***about*** 3.1 eV; the word "***about***" means that the Udagawa discloses for each of the "current diffusion layer" and the "cladding layer" a bandgap value that is slightly ***above*** or slightly ***below*** 3.1 eV; this logically means that Udagawa inherently discloses a case where the bandgap value of the "current diffusion layer" is slightly ***below*** 3.1 eV and the bandgap value of the "cladding layer" is slightly ***above*** 3.1 eV; therefore, Udagawa inherently discloses a case where, "***both*** the cladding layer and the current diffusion are… having a boron compositional gradient such that the bandgap increases in the thickness direction from the bottom surface of the cladding layer (slightly ***below*** 3.1 eV, as has been discusses above) closest to the light-emitting layer to the top of the current diffusion layer (slightly ***above*** 3.1 eV)").

Alternatively, Udagawa2 discloses in FIG. 1 and related text, **e.g.**, the cladding layer are composed of a boron- phosphide-based semiconductor having a boron compositional gradient such that the bandgap increases in the thickness direction from the bottom surface of the cladding layer (103; paragraph 47; "boron gallium phosphide (B.sub..alpha.Ga.sub..delta.P) layer in which the boron compositional proportion (.alpha.) is increased proportionally from 0.02 to 0.98" (from bottom to top)).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa with "both the cladding layer and the current diffusion (as a pair) having a boron compositional gradient such that the bandgap increases in the thickness direction from the bottom surface of the cladding laver closest to the light-emitting layer to the top of the current diffusion layer, in order to achieve better lattice matching between layers (see paragraph 47; it explains that the Boron content is "increased proportionally from 0.02 to 0.98" in the bottom cladding layer, in order to lattice match layers; therefore, it would be obvious to apply that teaching to a top cladding layer, in order to achieve the same end).

Regarding claim 2, Udagawa discloses in FIG. 6 and related text, **e.g.**, the current diffusion layer (607) is composed of at least one species selected from among boron monophosphide, boron gallium indium phosphide represented by a compositional formula B.sub..alpha.Ga.sub..gamma.In.sub.1-.alpha.-.gamma.P (0<.alpha..ltoreq.1, 0.ltoreq..gamma.<1), boron nitride phosphide represented by a compositional formula BP.sub.1-.delta.N.sub..delta. (0.ltoreq..delta.<1), and boron arsenide phosphide represented by a compositional formula B.sub..alpha.P.sub.1-.delta.As.sub..delta. (paragraph 128; "n-type BP").

Regarding claim 3, Udagawa discloses in FIG. 6 and related text, **e.g.**, the difference between the bandgap at room temperature (3.1 eV) of the current diffusion layer (607) and the bandgap at room temperature of the light-emitting layer (604; 2.9 eV) is 0.1 eV or more.

Regarding claim 4, Udagawa discloses in FIG. 2 and related text, **e.g.**, the current diffusion layer (607) has a bandgap at room temperature of 2.8 eV to 5.0 eV (3.1 eV).

Regarding claim 10, Udagawa discloses in FIG. 6 and related text, **e.g.**, an Ohmic contact electrode (608) is joined to the current diffusion layer (607).

Regarding claim 12, Udagawa discloses in FIG. 6 and related text, **e.g.**, substantially the entire claimed structure, as recited in claim(s) 1, except the cladding layer and the current diffusion layer have a boron compositional gradient such that the boron content increases in the thickness direction from the bottom of the cladding layer closest to the light-emitting layer to the top of the current diffusion layer.

Udagawa2 discloses in FIG. 1 and related text, **e.g.**, the cladding layer (103) have a boron compositional gradient such that the boron content increases in the thickness direction from the bottom of the cladding layer (see paragraph 47; it discloses that the layer is formed from "boron gallium phosphide (B.sub..alpha.Ga.sub..delta.P) layer in which the boron compositional proportion (.alpha.) is increased proportionally from 0.02 to 0.98" (from bottom to top).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa with the cladding layer and the current diffusion layer have a boron compositional gradient such that the boron content increases in the thickness direction from the bottom of the cladding layer closest to the light-emitting layer to the top of the current diffusion layer, in order to lattice match between layers (see paragraph 47; it explains that the

Boron content is "increased proportionally from 0.02 to 0.98", in order to lattice match layers; therefore, it would be obvious to apply that teaching to other layers, in order to achieve the same end).

5. **Claim(s) 5 & 11** are rejected under 35 U.S.C. 103(a) as being unpatentable over (US-2003/0234400) by Udagawa in view of (US-2003/0027099) by Udagawa ("Udagawa2").

Regarding claim 5, Udagawa and Udagawa2 disclose in cited figured and related text, **e.g.**, substantially the entire claimed structure, as recited in claim(s) 1, including a thickness of 50 nm to 5,000 nm (Udagawa; paragraph 128).

Udagawa and Udagawa2 do not disclose the current diffusion layer ***has a carrier concentration at room temperature of 1 x 1019 cm-3 or more, a resistivity at room temperature of 5 x 10-2 f2"cm or less***.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa and Udagawa2 with the current diffusion layer ***has a carrier concentration at room temperature of 1 x 1019 cm-3 or more, a resistivity at room temperature of 5 x 10-2 f2"cm or less***, in order to improve the conductivity of the device.

Generally, differences in carrier concentration or resistivity do not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such carrier concentration or resistivity is critical. "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller , 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). See also In re Hoeschele , 406 F.2d 1403, 160 USPQ 809 (CCPA 1969). For more recent cases applying this principle, see Merck & Co. Inc . v. Biocraft Laboratories Inc. , 874 F.2d 804, 10

USPQ2d 1843 (Fed. Cir.), cert. denied , 493 U.S. 975 (1989), and In re Kulling , 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990).

Regarding claim 11, Udagawa and Udagawa2 disclose in cited figured and related text, **e.g.**, substantially the entire claimed structure, as recited in claim(s) 1, including the cladding layer and the current diffusing layer have a bandgap which increases ***0.2*** eV or more (when compared to the light- emitting layer; see rejection of claim 1) in the thickness direction from the bottom of the cladding layer closest to the light- emitting layer to the top of the current diffusion layer ("in the thickness direction ... etc, is explained with regards to claim 1).

Udagawa and Udagawa2 do not disclose the cladding layer and the current diffusing layer have a bandgap which increases ***0.6*** eV or more.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa and Udagawa2 with the cladding layer and the current diffusing layer have a bandgap which increases ***0.6*** eV or more, in order to improve the characteristics of the device.

Generally, differences in bandgap do not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such differences are critical. "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller , 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). See also In re Hoeschele , 406 F.2d 1403, 160 USPQ 809 (CCPA 1969). For more recent cases applying this principle, see Merck & Co. Inc . v. Biocraft Laboratories Inc. , 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied , 493 U.S. 975 (1989), and In re Kulling , 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990).

6. **Claim(s) 7** is rejected under 35 U.S.C. 103(a) as being unpatentable over (US-2003/0234400) by Udagawa and (US-2003/0027099) by Udagawa ("Udagawa2") and further in view of (US-2004/0026703) by Adomi et al ("Adomi").

Regarding claim 7, Udagawa and Udagawa2 disclose in cited figures and related text, **e.g.**, substantially the entire claimed structure, as recited in claim(s) 1 & 6, except the cladding layer is composed of a Group III-V compound semiconductor ***containing aluminum, gallium, and indium***, and the current diffusion layer is composed of a boron-phosphide-based semiconductor containing ***at least one species selected from among aluminum, gallium, and indium***.

Adomi discloses in FIG. 2 and related text, **e.g.**, the cladding layer (43) is composed of a Group III-V compound semiconductor ***containing aluminum, gallium, and indium*** (paragraph 39; "AlGaInP").

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa and Udagawa2 with the cladding layer is composed of a Group III-V compound semiconductor ***containing aluminum, gallium, and indium***, and the current diffusion layer is composed of a boron-phosphide-based semiconductor containing ***at least one species selected from among aluminum, gallium, and indium,*** in order to improve the characteristics of the device by taking advantage of a direct transition material with a large bandgap, well-suited for formation of cladding layers (see Adomi, paragraph 39), and in order to use the device in an application capable of transmitting emitted light having a wavelength longer than about 443 nm (see Udagawa, paragraph 99, "boron indium phosphate"), respectively.

7. **Claim(s) 9** is rejected under 35 U.S.C. 103(a) as being unpatentable over (US-

2003/0234400) by Udagawa and (US-2003/0027099) by Udagawa ("Udagawa2") and further in view of (US-2003/0218180) by Fujiwara.

Regarding claim 9, Udagawa and Udagawa2 disclose in cited figures and related text, **e.g.**, substantially the entire claimed structure, as recited in claim(s) 1, including at least one of the current diffusion layer (Udagawa; 607) and the cladding layer (605) are composed of an undoped boron-phosphide-based semiconductor to which no impurity element has been intentionally added (no intentional doping is disclosed for layer 605; paragraphs 127 & 128).

Udagawa and Udagawa2 do not disclose the light-emitting layer ***is composed of an aluminum gallium indium phosphide mixed crystal represented by a compositional formula Al.sub.XGa.sub.YIn.sub.ZP (0.ltoreq.X, Y, Z.ltoreq.1, X+Y+Z=1)***.

Fujiwara discloses, **e.g.**, the light-emitting layer ***is composed of an aluminum gallium indium phosphide mixed crystal represented by a compositional formula Al.sub.XGa.sub.YIn.sub.ZP (0.ltoreq.X, Y, Z.ltoreq.1, X+Y+Z=1)*** (paragraph 4; "AlGaInP active layers").

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa and Udagawa2 with the light-emitting layer ***is composed of an aluminum gallium indium phosphide mixed crystal represented by a compositional formula Al.sub.XGa.sub.YIn.sub.ZP (0.ltoreq.X, Y, Z.ltoreq.1, X+Y+Z=1)***, in order to use the device in an application that required the use of orange/yellow light LED (see Fujiwara, paragraph 4).

Allowable Subject Matter

1. **Claim 13** is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

1. Applicant's arguments with respect to claims 1-5, 7 & 9-13 have been considered but are moot in view of the new ground(s) of rejection.

The Examiner wishes to point out that the claim limitations of "wherein ***both*** the cladding layer and the current diffusion" in claim 1, merely require that ***each of*** the layers meet the claim limitations of "are composed of a boron- phosphide-based semiconductor having a boron compositional gradient" and the limitations "such as…" merely require that the layers, ***as a pair***, meet the limitations and not each layer individually.

Furthermore, the claim limitations of "the bandgap increases ***in the thickness direction from the bottom surface of the cladding layer closest to the light-emitting layer to the top of the current diffusion layer***" in claim 1, merely give the detailed description of the ***direction*** in which the bandgap needs to increase, and place no other requirements.

In case if the Examiner has understood correctly what the Applicant has meant to claim, then the Applicant may wish to amend the relevant portion of claim 1 to read as follows:

"wherein ~~both~~ ***each of*** the cladding layer and the current diffusion ***layer*** are composed of a boron- phosphide-based semiconductor having a boron compositional gradient such that the bandgap increases ~~in the thickness direction~~ from the bottom surface of the cladding layer closest

to the light-emitting layer ***to a top surface of the cladding layer and from the top surface of the cladding layer*** to a top surface of the current diffusion layer."

The above removes "the thickness direction" adds what the Applicant probably meant by "both" and overcomes the cited prior art references.

Conclusion

1. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexander Belousov whose telephone number is 571-270-3209. The examiner can normally be reached on Monday - Thursday 7:30AM - 5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kimberly Nguyen can be reached on 571-272-2402. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Alexander Belousov/
Examiner, Art Unit 2894
12/11/2008

/Kimberly D Nguyen/
Supervisory Patent Examiner, Art Unit 2894